Entergy

Entergy Nuclear Vermont Yankee, LLC
Entergy Nuclear Operations, Inc.
185 Old Ferry Road
Brattleboro, VT 05302-0500

February 25, 2004
BVY 04-023

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: **Vermont Yankee Nuclear Power Station**
License No. DPR-28 (Docket No. 50-271)
Technical Specification Proposed Change No. 262 – Supplement No. 10
Alternative Source Term
Response to Request for Additional Information

This letter provides a response to NRC's request of February 18, 2004[1] for additional information regarding Vermont Yankee's[2] (VY) proposed revision to the licensing basis for the Vermont Yankee Nuclear Power Station (VYNPS) by incorporating full scope application of an Alternative Source Term methodology. By letter dated July 31, 2003, as supplemented by letters dated October 10, 2003, November 7, 2003 (two letters), November 20, 2003, December 11, 2003 (two letters), December 30, 2003, February 10, 2004, and February 18, 2004, VY proposed to amend Facility Operating License No. DPR-28 for VYNPS.

Attachment 1 to this letter provides a response to the request for additional information (RAI). The responses to the RAIs were also the subject of a telephone conference call held between NRC staff and representatives of VY on February 19, 2004.

This supplement to the license amendment request does not change the scope or conclusions in the original application, nor does it change VY's determination of no significant hazards consideration.

If you have any questions, please contact Mr. James DeVincentis at (802) 258-4236.

Sincerely,

Robert J. Wanczyk
Director, Nuclear Safety Assurance

[1] A draft request for additional information was transmitted on February 18, 2004, to VY as documented in NRC memorandum from Richard B. Ennis to Darrell J. Roberts under TAC No. MC0253.
[2] Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. are the licensees of the Vermont Yankee Nuclear Power Station.

A001

STATE OF VERMONT)
)ss
WINDHAM COUNTY)

Then personally appeared before me, Robert J. Wanczyk, who, being duly sworn, did state that he is Director, Nuclear Safety Assurance of the Vermont Yankee Nuclear Power Station, that he is duly authorized to execute and file the foregoing document, and that the statements therein are true to the best of his knowledge and belief.

Sally A. Sandstrum

Sally A. Sandstrum, Notary Public
My Commission Expires February 10, 2007

SALLY A. SANDSTRUM
NOTARY PUBLIC
WINDHAM COUNTY, VERMONT

Attachment

cc: USNRC Region 1 Administrator (w/o attachment)
USNRC Resident Inspector – VYNPS (w/o attachment)
USNRC Project Manager – VYNPS
Vermont Department of Public Service

Docket No. 50-271
BVY 04-023

Attachment 1

Vermont Yankee Nuclear Power Station

Proposed Technical Specification Change No. 262 – Supplement No. 10

Alternative Source Term

Response to Request for Additional Information

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
RELATED TO ALTERNATIVE SOURCE TERM AMENDMENT REQUEST
VERMONT YANKEE NUCLEAR POWER STATION

RAI No. 1

The SLC system should be classified as a safety-related system as defined in 10 CFR 50.2, and satisfy the regulatory requirements for such systems.

If the SLC system is not classified as safety-related, provide information to show that the SLC system is comparable to a system classified as safety-related. A SLC system meeting items (a)-(e) below would result in its acceptance in support of a 10 CFR 50.67 request even if the system is not classified as safety-related.

(a) The SLC system should be provided with standby AC power supplemented by the emergency diesel generators.

(b) The SLC system should be seismically qualified in accordance with Regulatory Guide (RG) 1.29 and Appendix A to 10 CFR Part 100 (or equivalent used for original licensing).

(c) The SLC system should be incorporated into the plant's American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) inservice inspection (ISI) and inservice test (IST) Programs based upon the plant's Code of record (10 CFR 50.55a).

(d) The SLC system should be incorporated into the plant's Maintenance Rule program consistent with 10 CFR 50.65.

(e) The SLC system should meet 10 CFR 50.49 and Appendix A to 10 CFR 50 (General Design Criterion (GDC) 4, or equivalent used for original licensing).

Response to RAI No. 1

The Standby Liquid Control (SLC) system at the Vermont Yankee Nuclear Power Station (VYNPS) is classified as a safety-related system as defined in 10CFR50.2 and satisfies the regulatory requirements for such systems. The SLC system at VYNPS meets the following items:

(a) The SLC system is provided with standby AC power supplemented by the emergency diesel generators.

(b) VYNPS was licensed prior to the adoption of Appendix A to 10CFR100. As described in the VYNPS Updated Final Safety Analysis Report (UFSAR), the SLC system equipment and piping were originally designed to Seismic Class I requirements. SLC system piping outside the drywell was subsequently reanalyzed and supports were modified under the seismic piping reanalysis program. A dynamic analysis of the piping was performed to evaluate seismic loads using response spectra based on Regulatory Guide 1.60 ground response spectra and ASME Code Case N-411 damping.

(c) The applicable components of the SLC system are inspected and tested in accordance with the VYNPS ASME Boiler and Pressure Vessel Code inservice inspection (ISI) and inservice testing (IST) programs as required by 10CFR50.55(a).

(d) The SLC system is in the VYNPS Maintenance Rule program consistent with 10CFR50.65.

(e) The new Alternative Source Term (AST) based post Loss of Coolant Accident (LOCA) mission for the SLC system has been evaluated for environmental qualification of electric equipment important to safety. The environmental conditions are discussed in the response to RAI No. 4(a)(2).

In addition, because the SLC system satisfies criterion 4 of 10CFR50.36(c)(2)(ii), appropriate Technical Specification limiting conditions for operation have been established.

RAI No. 2

The licensee should have plant procedures for injecting the sodium pentaborate using the SLC system.

(a) Have the SLC activation steps been placed in a safety-related plant procedure? Provide the procedure for staff review.

(b) Are the steps activated by parameters that are symptoms of imminent or actual core damage?

(c) Does the instrumentation relied upon to provide this indication meet the quality requirements for a Type E variable as defined in RG 1.97 Tables 1 and 2?

(d) Will plant personnel receive initial and periodic refresher training in the procedure?

(e) Will other plant procedures (e.g., Emergency Response Guidelines (ERGs)/Severe Accident Guidelines (SAGs)) that call for termination of SLC as a reactivity control measure be appropriately revised to enable SLC injection for pH control?

Response to RAI No. 2(a)

The steps necessary for the control room operator to manually initiate SLC injection are contained as an appendix to the SLC system operating procedure, which is a "safety related" procedure. A controlled copy of this appendix is staged at the control room panel near the SLC system controls and indications.

As discussed in the Safety Assessment accompanying Vermont Yankee's (VY) July 31, 2003 license amendment request, initiation of the SLC system for control of the suppression pool pH will be based on high drywell radiation levels. The annunciator response procedures for drywell high radiation are being revised to require SLC injection before drywell radiation reaches 4,000 R/hr. The control room annunciators currently actuate at a drywell radiation level of approximately 1,000 R/hr. The revised procedures will be issued prior to completing implementation of the alternative source term (AST) license amendment.

In addition, the "RPV Control" Emergency Operating Procedure (EOP) lists the SLC system as an alternate injection sub-system. Since the AST event involves a loss of all other normal and emergency injection sub-systems, SLC injection would be initiated based on low RPV water level.

Changes to the SLC system operating procedure, the annunciator response procedures and the RPV Control EOP are controlled by the 10CFR50.59 process. In addition, the AST event would result in entry into the Severe Accident Guidelines (SAGs). The SAGs currently contain instructions to inject SLC upon entry.

Based on a February 19, 2004 telecon with the NRC staff, it was understood that the above procedure descriptions are adequate and providing copies of the procedures is not necessary.

Response to RAI No. 2(b)

The parameter that will be used to direct activation of the SLC system is high drywell radiation as indicated on the Containment High-Range Radiation Monitors. High drywell radiation is a symptom of actual core damage.

In addition, SLC injection would also be directed based on low RPV water level (when water level can not be maintained above top of active fuel), which is a symptom of imminent core damage.

Response to RAI No. 2(c)

The drywell high radiation instruments are required to be operable by Technical Specification 3.2.G, "Post-Accident Instrumentation". The drywell high range radiation monitors meet the quality requirements for a Type E variable as defined in Regulatory Guide 1.97, Tables 1 and 2. The reactor water level instruments meet the quality requirements for a Type B variable as defined in Regulatory Guide 1.97, Tables 1 and 2.

Response to RAI No. 2(d)

Licensed personnel and Shift Technical Advisors will be initially trained and receive periodic refresher training on these procedures as part of the Licensed Operator Requalification Training Program. Initial training on the procedure revisions discussed in 2(a) above will be conducted prior to completing implementation of the AST license amendment.

Response to RAI No. 2(e)

The only procedure that calls for termination of SLC as a reactivity control measure is the Emergency Operating Procedure (EOP), "ATWS RPV Control." This procedure is only entered if the reactor will not remain shutdown under all conditions (i.e., an ATWS event). Since the AST severe accident scenario does not assume that an ATWS event has occurred, this EOP is not applicable and does not require revision.

RAI No. 3

A sufficient concentration and quantity of sodium pentaborate should be available for injection into the reactor vessel to control pH in the suppression pool. The licensee has previously provided this information in its July 31, 2003 submittal, as supplemented.

The source term analysis is tied to the plant's design basis accident, which is the large break LOCA, a break of a recirculation pipe. Demonstrate that within 24 hours there is adequate recirculation between the suppression pool and the reactor vessel through flow out the break to provide transport and mixing, consistent with the assumptions in the chemical analyses.

Response to RAI No. 3

The source term analysis is associated with a loss of coolant accident inside the primary containment. The initial liquid volume of the suppression pool and the reactor pressure vessel (RPV) is approximately 79,000 ft^3. An electrical division single failure is assumed resulting in one residual heat removal (RHR) system pump and one core spray (CS) system pump available for containment spray and RPV flooding, respectively. One RHR pump is capable of injecting 6,650 gpm and a CS pump is capable of injecting a minimum of 3,000 gpm, or approximately 53,000 ft^3/hr and 24,000 ft^3/hr, respectively.

Mixing can be conservatively considered to start at the end of approximately 4.3 hours. This time corresponds to the complete injection of sodium pentaborate and includes the flooding of the RPV. The time is consistent with the event timing in Regulatory Guide 1.183 where the first two hours is without RPV emergency core cooling system (ECCS) injection. The first two hours are followed by the start of sodium pentaborate injection by the SLC system and the refill of the RPV by one CS pump. Mixing begins with liquid spillage from the break to the primary containment. The bottom of the drywell (DW) would already be flooded from the RPV blowdown condensation and DW sprays.

The mixing evaluation conservatively includes the RPV volume and the volume of the main steam (MS) lines to the outboard main steam isolation valves (MSIV) which is approximately 16,176 ft^3 . This volume is filled in about 40 minutes. The additional CS inventory delivered to the RPV mixes with the sodium pentaborate, spills from the RPV, making the sodium pentaborate available for mixing. The drywell sprays and the spilled ECCS flow provide the suppression pool mixing. Even if DW sprays were eventually secured, the flow of at least one RHR pump in the low pressure coolant injection (LPCI) mode of RHR would provide the ECCS spillage and the associated mixing flow.

Suppression pool turnover of one volume is calculated to be approximately 1.5 hr. A three volume turn-over for adequate mixing can be achieved very conservatively in less than 9 hours post-LOCA (4.3 hours for complete filling of the RPV and 4.5 hours for post-RPV refill mixing) which is well within 24 hours. In 24 hours, a volume turn-over of approximately 13 times would be achieved in the suppression pool.

RAI No. 4

The SLC system should not be rendered incapable of performing its AST function due to a single failure of an active component. For this purpose the check valve is considered an active device for AST since the check valve must open to inject sodium pentaborate for suppression pool pH control.

If the SLC system can not be considered redundant with respect to its active components, this lack of redundancy may be offset by providing information in (a) or (b) or (c) below:

(a) Show acceptable quality and reliability of the non-redundant active components and/or compensatory actions in the event of failure of the non-redundant active components.

If you choose this option, provide the following information to justify the lack of redundancy of active components in the SLC system:

(1) Identify the non-redundant active components in the SLC system and provide their make, manufacturer, and model number.

(2) Provide the design-basis conditions for the component and the environmental and seismic conditions under which the component may be required to operate during a design-basis accident. Environmental conditions include design-basis pressure, temperature, relative humidity and radiation fields.

(3) Indicate whether the component was purchased in accordance with Appendix B to 10CFR Part 50. If the component was not purchased in accordance with Appendix B, provide information on the quality standards under which it was purchased.

(4) Provide the performance history of the component both at the licensee's facility and in industry databases such as EPIX and NPRDS

(5) Provide a description of the component's inspection and testing program, including standards, frequency, and acceptance criteria.

(6) Indicate potential compensating actions that could be taken within an acceptable time period to address the failure of the component. An example of a compensating action might be the ability to jumper a switch in the control room to overcome its failure. The staff reviewer will consider the availability of compensating actions and the likelihood of successful injection of the sodium pentaborate where non-redundant active components fail to perform their intended functions.

OR

(b) Provide for an alternative success path for injecting chemicals into the suppression pool.

If you choose to address the SLC system's susceptibility to single failure by selecting an alternative injection path, the alternative path must be capable of performing the AST function noted above and all components which make up the alternative path should meet the same quality characteristics required of the SLC system (described in Items 1(a)-1(e), 2 and 3 above). Provide a description of the alternative injection path, its capabilities, and quality characteristics.

If the use of an alternate path is part of the Emergency Operating Procedures (EOPs), then the license amendment request needs to address the following items: (1) Does the alternate injection path require actions in areas outside the control room? (2) How accessible will these areas be? (3) What additional personnel will be required?

OR

(c) Show that 10 CFR 50.67 and Appendix A, GDC 19 doses are met even if pH is not controlled.

You may choose to demonstrate, through dose calculations, that 10 CFR 50.67 and GDC 19 (or equivalent used in original licensing) doses are met even if pH is not controlled. The re-evolution of iodine in the particulate form from the water in the suppression pool to the elemental form for airborne iodine must be incorporated into the calculation. The calculation may take credit for the mitigating capabilities of other equipment, for example the standby gas treatment system (SGTS), if such equipment would be available. If you choose this option, please provide the dose calculations (including all inputs and assumptions) and any supporting calculations on re-evolution of iodine.

Response to RAI No. 4

The VYNPS SLC system can be considered redundant with respect to its active components, except as outlined below. However, this limited lack of redundancy is offset as described in the justifications provided. The following information is provided in accordance with RAI No. 4, Option (a). Therefore, Options (b) and (c) are not applicable to VYNPS.

Response to RAI No. 4(a)(1)

(Note: VYNPS' licensing basis considers check valves to be passive components. Nevertheless, this discussion provides additional justification for the acceptability of these components.)

The non-redundant active components of the SLC system are (1) the check valves (two in series) located on containment penetration X-42 for the SLC injection line and, (2) the SLC initiation control switch located on Control Panel 9-5 in the main control room. The make, manufacturer, and model number (as applicable) for the check valves and control switch are as follows:

Check Valves

V11-16 & 17 Type: Piston Lift Check Mfr.: Rockwell-Edwards Model: 3674

Switch

11A-S1 Type: Single Block Module (SBM) Mfr.: General Electric

Response to RAI No. 4(a)(2)

The seismic design is discussed in the response to RAI 1(b). The post-LOCA environmental conditions for the SLC system have been evaluated with respect to the SLC system mission. The SLC system mission time (i.e., time at which SLC injection is complete) is approximately 4.3 hours post-LOCA.

The post-LOCA reactor building environmental conditions of interest are temperature and radiation. Pressure and humidity are not environmental factors since the LOCA is in the drywell. The post-LOCA reactor building heat-up is primarily due to the increase in suppression pool temperature. The radiological environment in the reactor building is from the drywell source term that is assumed to leak into the reactor building at the maximum allowable leakage rate.

The VYNPS Equipment Qualification (EQ) program considers a "mild" temperature environment to exist when the post accident ambient temperature rise is less than 10°F above the normal temperature (assumed to be 100°F). For radiation exposure, a "mild" environment is defined as an integrated dose, including the accident dose, that is less than 1E+05 R (approximately 8.8E+04 rad in air) after 40 years, or the dose received during the accident is less than 1E+04 R (approximately 8.8E+03 rad in air) regardless of the normal operating exposure. Per the VYNPS EQ program, equipment that completes its mission while the environment is "mild" are included in the program but do not have to be environmentally qualified.

The post-LOCA reactor building temperature increase at the SLC system and associated motor control center locations do not exceed 10°F over the first 24 hours. One reactor building area where SLC system power cables traverse increases approximately 15°F at 24 hours. These cables are identical to qualified cables which are environmentally qualified to the post-LOCA drywell temperature environment. Therefore, these SLC system cables will not fail due to a post-LOCA reactor building temperature rise of 15°F corresponding to an ambient temperature of 115°F. These cables will be included in the EQ program.

The radiological EQ evaluation included a conservative 40 year integrated dose projection for the SLC components. The combined post-LOCA dose and the 40 year dose is calculated to be less than 7E+04 rad at 24 hours post-LOCA. Therefore, from a radiological perspective, the SLC system completes its mission while the environment remains mild. The SLC system equipment will be included in the EQ program, but does not have to be environmentally qualified.

These updates to the VY EQ program will be completed prior to completing implementation of the AST license amendment.

Response to RAI No. 4(a)(3)

The SLC injection check valves and SLC control switch were purchased as original equipment for VYNPS and were subject to the same requirements as other components installed in safety related systems. They are designated as Safety Class 1 Mechanical and Safety Class Electrical, respectively, and are maintained within the requirements of VYNPS' 10CFR50 Appendix B QA program.

Response to RAI No. 4(a)(4)

VY has researched the performance history of the two components which are not functionally redundant within the SLC system using the VYNPS maintenance database, EPIX (Equipment Performance and Information Exchange) and NPRDS (Nuclear Plant Reliability Data System). The applicable performance history is detailed below:

Check Valves

A review of VYNPS' specific maintenance history, EPIX, and NPRDS indicates that for a "fail to open" failure mode there have been five failures recorded (none at VYNPS). These failures occurred due to the deposition of corrosion products, boric acid, or unspecified debris within the system.

The performance history results are:

VYNPS Maintenance History: No failures of these specific check valves have been recorded.

EPIX: A review of EPIX for failure of Rockwell/Edwards check valves, model 3674, indicates that only one occurrence of a failure to open has occurred. This failure was attributed to debris in the valve.

NPRDS: A review of NPRDS for failure of Rockwell/Edwards check valves, model 3674, indicates there were four (4) occurrences of "fail to open." The four "fail to open" occurrences were due to: valve stuck due to corrosion on valve, valve stuck due to corrosion (carbon steel valve), plugged with solidified boric acid, and deposition of extraneous material.

These failure modes are considered highly unlikely at VYNPS due to the design of the valve (corrosion resistant), the normally inactive nature of the system (tested once per cycle with demineralized water), and the high differential pressure anticipated when called upon to operate (the pumps and system are capable of generating in excess of 1,400 psid to ensure sodium pentaborate injection). Additionally, testing of the injection capability of the SLC system is performed during each refueling outage as required by the IST program. No failure to inject has occurred as a result of the check valves failing to move to their required position.

The EPIX and NPRDS reviews along with VYNPS performance history demonstrate the SLC system check valves are of acceptable quality and reliability.

Control Switch

SLC control switch 11A-S1 provides a common point within the control circuit for SLC system actuation. All contacts on the switch are arranged to maintain electrical separation. Wiring to the switch is separated into bundles in accordance with applicable VYNPS separation criteria. The only common elements on the switch are the actuating knob, the operating shaft and the cams that operate the contacts which are therefore limited in their failure potential.

The SBM type switch is widely used in many variations throughout the industry. A review of industry operating experience indicates that several modes of failure have occurred involving corroded or dirty contacts and defective cam followers on control switches. These failure mechanisms have been widely reported (e.g., NRC Information Notices 80-13, 98-19, and 2003-18).

As discussed in the response to RAI No. 4(a)(6) below, VY believes the SLC switch is highly reliable. Nonetheless, based on the industry performance history, VY will implement compensatory procedures to address a potential failure.

Response to RAI No. 4(a)(5)

SLC check valve and SLC control switch functional testing is accomplished each refueling outage during the flow test which directs demineralized water into the RPV at rated SLC pump flow. This testing consists of a functional test of the SLC system and requires initiation of one train of SLC, from the control room, using the SLC test tank as a source of demineralized water. Therefore, functional testing of each of these components is accomplished once per cycle.

Response to RAI No. 4(a)(6)

The SLC system at VYNPS is a safety related system and its availability is governed by the Technical Specifications. SLC is suitably redundant in components and features to assure that its safety function can be accomplished. VY has addressed, in the Safety Assessment accompanying the July 31, 2003 AST submittal, one active and one passive potential failure that could impact the SLC system. The assumed active failure is in the single control room key-locked-switch and associated logic that actuates SLC. The assumed passive failure is one of the two check valves in series on the injection line that are credited to change state to inject the SLC solution. The SLC check valves are considered highly reliable and the lack of functional redundancy is offset by the reliability as discussed in the response to RAI Nos. 4(a)1-5 above. Therefore, no additional compensatory actions are considered necessary to ensure injection of SLC through this flow path.

The Safety Assessment included a mean failure frequency for manual switches (toggle, rotary and push button) in the range of 2.4E-05 per demand. The switch is rated for approximately 500,000 mechanical operations and is normally operated only a few times per refueling outage. The high mechanical rating and limited operational use indicate that the switch has a high degree of reliability. Therefore, a failure to actuate the SLC system, through mechanical failure of the switch, is considered unlikely at VYNPS. Nevertheless, several failure mechanisms have been noted within the industry which could indicate that a potential active failure of the switch might occur which could, temporarily, impact initiation of SLC. A failure of the key-locked switch, however, could be readily addressed in the control room considering that SLC injection is really not necessary for the first two hours. Therefore, VYNPS plant procedures will be modified prior to completing implementation of the AST license amendment to provide instruction to jumper switch contacts in the event that a failure of the switch were to occur.